



USB1 gene

U6 snRNA biogenesis phosphodiesterase 1

Normal Function

The *USB1* gene provides instructions for making an enzyme that functions as an RNA exonuclease. RNA exonucleases cut off (cleave) building blocks called nucleotides one at a time from molecules of RNA (a chemical cousin of DNA). This process helps stabilize the RNA and protects it from damage.

Specifically, the *USB1* enzyme protects a small RNA molecule called U6, which is an essential component of a complex called a spliceosome. The *USB1* enzyme also helps transport (chaperones) U6 to the spliceosome and helps it attach (bind) to the proteins in the complex. Spliceosomes process RNA molecules called messenger RNAs (mRNAs) by recognizing and removing regions known as introns and splicing the mRNA molecules back together to provide the blueprint for making proteins.

Different versions (isoforms) of the *USB1* enzyme are produced in different tissues, where they play various roles. In blood-forming tissues, the *USB1* enzyme is thought to be important for the maturation of neutrophils. Neutrophils are a type of white blood cell involved in the immune system. In the skin, the *USB1* enzyme is found in pigment-producing cells (melanocytes), cells in the outer layer of the skin called keratinocytes, and structural cells called fibroblasts. Its role in the function of these cells is unknown.

Health Conditions Related to Genetic Changes

Poikiloderma with neutropenia

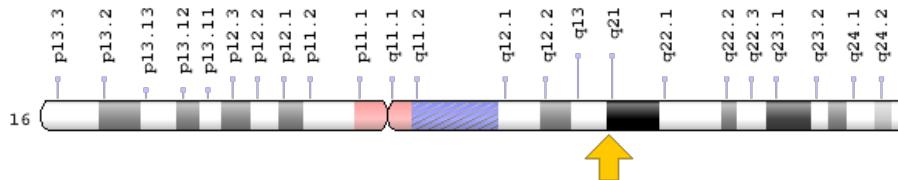
At least 24 mutations in the *USB1* gene have been identified in people with poikiloderma with neutropenia (PN). This condition involves a group of skin abnormalities called poikiloderma and a persistent shortage (deficiency) of neutrophils (chronic neutropenia).

The *USB1* gene mutations that cause PN are thought to lead to an enzyme whose function is impaired. As a result of the dysfunctional *USB1* exonuclease, the U6 RNA is not protected from damage and not correctly chaperoned to the spliceosomes, leading to impairment of key biological functions. The specific connection between *USB1* gene mutations and the signs and symptoms of PN is unknown. However, the existence of tissue-specific isoforms of the enzyme could help explain why this disorder mainly affects the skin and immune system.

Chromosomal Location

Cytogenetic Location: 16q21, which is the long (q) arm of chromosome 16 at position 21

Molecular Location: base pairs 57,999,603 to 58,021,618 on chromosome 16 (Homo sapiens Updated Annotation Release 109.20200522, GRCh38.p13) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- C16orf57
- chromosome 16 open reading frame 57
- hMPN1: mutated in PN1
- U six biogenesis 1
- U6 small nuclear RNA biogenesis phosphodiesterase 1
- U6 snRNA biogenesis 1

Additional Information & Resources

Educational Resources

- Genomes (second edition, 2002): Synthesis and Processing of RNA
<https://www.ncbi.nlm.nih.gov/books/NBK21132/>

Clinical Information from GeneReviews

- Poikiloderma with Neutropenia
<https://www.ncbi.nlm.nih.gov/books/NBK459118>

Scientific Articles on PubMed

- PubMed
<https://www.ncbi.nlm.nih.gov/pubmed?term=%28%28USB1%5BTIAB%5D%29+OR+%28U6+snRNA+biogenesis+phosphodiesterase+1%5BTIAB%5D%29%29+OR+%28C16orf57%5BTIAB%5D%29+OR+%28HVSL+motif+containing+1%5BTIAB%5D%29+OR+%28Mpn1%5BTIAB%5D%29+OR+%28U+six+biogenesis+1%5BTIAB%5D%29+OR+%28U6+snRNA+biogenesis+1%5BTIAB%5D%29+OR+%28mutated+in+poikiloderma+with+neutropenia+protein+1%5BTIAB%5D%29+OR+%28putative+U6+snRNA+phosphodiesterase%5BTIAB%5D%29%29+AND+%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D>

Catalog of Genes and Diseases from OMIM

- U6 SMALL NUCLEAR RNA BIOGENESIS PHOSPHODIESTERASE 1
<http://omim.org/entry/613276>

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
<http://atlasgeneticsoncology.org/Genes/USB1ID44608ch16q21.html>
- ClinVar
<https://www.ncbi.nlm.nih.gov/clinvar?term=USB1%5Bgene%5D>
- HGNC Gene Symbol Report
https://www.genenames.org/data/gene-symbol-report/#!/hgnc_id/HGNC:25792
- Monarch Initiative
<https://monarchinitiative.org/gene/NCBIGene:79650>
- NCBI Gene
<https://www.ncbi.nlm.nih.gov/gene/79650>
- UniProt
<https://www.uniprot.org/uniprot/Q9BQ65>

Sources for This Summary

- Colombo EA, Bazan JF, Negri G, Gervasini C, Elcioglu NH, Yucelten D, Altunay I, Cetincelik U, Teti A, Del Fattore A, Luciani M, Sullivan SK, Yan AC, Volpi L, Larizza L. Novel C16orf57 mutations in patients with Poikiloderma with Neutropenia: bioinformatic analysis of the protein and predicted effects of all reported mutations. *Orphanet J Rare Dis.* 2012 Jan 23;7:7. doi: 10.1186/1750-1172-7-7.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/22269211>
Free article on PubMed Central: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3315733/>
- Didychuk AL, Montemayor EJ, Carrocci TJ, DeLaitch AT, Lucarelli SE, Westler WM, Brow DA, Hoskins AA, Butcher SE. Usb1 controls U6 snRNP assembly through evolutionarily divergent cyclic phosphodiesterase activities. *Nat Commun.* 2017 Sep 8;8(1):497. doi: 10.1038/s41467-017-00484-w.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/28887445>
Free article on PubMed Central: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5591277/>
- Hilcenko C, Simpson PJ, Finch AJ, Bowler FR, Churcher MJ, Jin L, Packman LC, Shlien A, Campbell P, Kirwan M, Dokal I, Warren AJ. Aberrant 3' oligoadenylation of spliceosomal U6 small nuclear RNA in poikiloderma with neutropenia. *Blood.* 2013 Feb 7;121(6):1028-38. doi: 10.1182/blood-2012-10-461491. Epub 2012 Nov 27.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/23190533>
- Mroczeck S, Dziembowski A. U6 RNA biogenesis and disease association. *Wiley Interdiscip Rev RNA.* 2013 Sep-Oct;4(5):581-92. doi: 10.1002/wrna.1181. Epub 2013 Jun 14. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/23776162>
- Mroczeck S, Krwawicz J, Kutner J, Lazniewski M, Kucinski I, Ginalski K, Dziembowski A. C16orf57, a gene mutated in poikiloderma with neutropenia, encodes a putative phosphodiesterase responsible for the U6 snRNA 3' end modification. *Genes Dev.* 2012 Sep 1;26(17):1911-25. doi: 10.1101/gad.193169.112. Epub 2012 Aug 16.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/22899009>
Free article on PubMed Central: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3435495/>
- Negri G, Crescenzi B, Colombo EA, Fontana L, Barba G, Arcioni F, Gervasini C, Mecucci C, Larizza L. Expanding the role of the splicing USB1 gene from Poikiloderma with Neutropenia to acquired myeloid neoplasms. *Br J Haematol.* 2015 Nov;171(4):557-65. doi: 10.1111/bjh.13651. Epub 2015 Aug 25.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/26306619>
- Shchepachev V, Azzalin CM. The Mpnn1 RNA exonuclease: cellular functions and implication in disease. *FEBS Lett.* 2013 Jun 27;587(13):1858-62. doi: 10.1016/j.febslet.2013.05.005. Epub 2013 May 15. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/23684637>
- OMIM: U6 SMALL NUCLEAR RNA BIOGENESIS PHOSPHODIESTERASE 1
<http://omim.org/entry/613276>
- Volpi L, Roversi G, Colombo EA, Leijsten N, Concolino D, Calabria A, Mencarelli MA, Fimiani M, Macchiardi F, Pfundt R, Schoenmakers EF, Larizza L. Targeted next-generation sequencing appoints c16orf57 as clericuzio-type poikiloderma with neutropenia gene. *Am J Hum Genet.* 2010 Jan;86(1):72-6. doi: 10.1111/j.ajhg.2009.11.014. Epub 2009 Dec 10. Erratum in: *Am J Hum Genet.* 2010 Sep 10;87(3):445.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/20004881>
Free article on PubMed Central: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2801743/>

- Walne AJ, Vulliamy T, Beswick R, Kirwan M, Dokal I. Mutations in C16orf57 and normal-length telomeres unify a subset of patients with dyskeratosis congenita, poikiloderma with neutropenia and Rothmund-Thomson syndrome. *Hum Mol Genet*. 2010 Nov 15;19(22):4453-61. doi: 10.1093/hmg/ddq371. Epub 2010 Sep 3.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/20817924>
Free article on PubMed Central: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2957322/>
- Wang L, Clericuzio C, Larizza L. Poikiloderma with Neutropenia. 2017 Oct 26. In: Adam MP, Ardinger HH, Pagon RA, Wallace SE, Bean LJH, Stephens K, Amemiya A, editors. GeneReviews® [Internet]. Seattle (WA): University of Washington, Seattle; 1993-2018. Available from <http://www.ncbi.nlm.nih.gov/books/NBK459118/>
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/29072891>

Reprinted from Genetics Home Reference:
<https://ghr.nlm.nih.gov/gene/USB1>

Reviewed: June 2018
Published: June 23, 2020

Lister Hill National Center for Biomedical Communications
U.S. National Library of Medicine
National Institutes of Health
Department of Health & Human Services